

Current Debates on Infrastructure Policy

Antonio Estache

Marianne Fay

The World Bank
Poverty Reduction and Economic Management Vice-Presidency
November 2007



Abstract

This paper provides an overview of the major current debates on infrastructure policy. It reviews the evidence on the macroeconomic significance of the sector in terms of growth and poverty alleviation. It also discusses the major institutional debates, including the relative

comparative advantage of the public and the private sector in the various stages of infrastructure service delivery as well as the main options for changes in the role of government (i.e. regulation and decentralization).

This paper—a product of the Poverty Reduction and Economic Management (PREM) Vice-Presidency—is part of a larger effort to gather the best understanding there is about the policies and strategies that underlie rapid economic growth and poverty reduction. Policy Research Working Papers are also posted on the Web at <http://econ.worldbank.org>. The author may be contacted at mfay@worldbank.org.

The Policy Research Working Paper Series disseminates the findings of work in progress to encourage the exchange of ideas about development issues. An objective of the series is to get the findings out quickly, even if the presentations are less than fully polished. The papers carry the names of the authors and should be cited accordingly. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

Current debates on infrastructure policy

Antonio Estache and Marianne Fay¹

¹ This paper was prepared for the Growth Commission (<http://www.growthcommission.org/>) Workshop on Global Trends and Challenges held on September 28-29, 2007 at Yale University. The authors are grateful to Eduardo Engel, Guillermo Perry, Stéphane Straub and workshop participants for comments received.

Introduction

The recent history of infrastructure policymaking perfectly illustrates the negative consequences of politicians and academics' attraction to fads. The problem with fads is an up-phase is necessarily followed by a down phase, regardless of the importance of the issue. This happened to infrastructure. It never stopped being important, although to different degree in different countries and at different stages of development. However, its standing in the agenda of researchers and policymakers has cycled through highs and lows in the last 20 years. This has resulted in an unfortunate slow-down in much needed investments and maintenance in the sector.

Consider the evolution over the last 25 years of the perception among politicians and academics of the public sector responsibility for electricity, telecoms, transport and water and sanitation. During the 1980s, with a few high-profile exceptions in the Anglo-Saxon world, these sectors were clearly seen as a public sector responsibility and governments were looking inward for means to improve their quality and volume. But during the nineties, these concerns largely disappeared from governments' agenda. Instead, received wisdom was that the private sector was going to take over these services, leaving only a residual role for governments (deregulation and restructuring, and the regulation of remaining residual monopolies). The time had come for the private sector to show what it could do after a frustrating long experience with an underperforming public sector.

The vision did not play out as expected. Almost 20 years after privatization began to be touted as the solution to infrastructure woes, the role of the large scale private sector in the delivery of infrastructure services in energy, water or transport is far from being as widespread as many had hoped for, at least in developing countries. This is why many governments have stopped betting on an acceleration of private investment in the sector for the years to come. Local micro- or small-scale private providers have jumped in to compensate for the failures of the model envisaged by the promoters of large scale privatizations as well as for the failures of the remaining public monopolies. But given the fact that scale economies are defining characteristics of most infrastructure services, this could mean higher than needed costs for residential users.

The costs of the failure to get the vision to materialize are not minor. There is a strong and widespread sense among policymakers that some of the differences in growth rates between East Asia and other parts of the world can be attributed to the failure to invest sufficiently in infrastructure. Users' frustration with the switch from tax financing of these services to user financing only worsened the unhappiness with the new vision. The related rejection of the privatization experience has now become an effective political campaign items for politicians around the world.

Today, many governments are struggled to compensate for the collective failures to improve infrastructure in the 1990s. Most developing countries need to compensate for the inherited investment gaps in large scale network expansions or on major maintenance of the existing networks. The public sector is once again seen as the major player in financing many of these expansion needs and for developing countries. And because of

the high costs and limited capacity to pay of many of the users, the donor community is expected to be a central actor in the scaling-up of the public investment efforts at least in the poorer countries.

The emerging new vision is no longer a dichotomous choice between public and private on the full spectrum of dimensions associated with infrastructure service delivery. Instead, pragmatism dominates. The public sector is expected to retain an important financing role while the private sector can help in meeting the very significant needs associated with infrastructure construction, operation and/or to some extent financing in sectors such as telecoms, energy generation and transport services. This evolution is actually observed around the world, in developed as well as in developing countries.

The paper is organized as follows. Section 2 offers an overview of the current state of the sector while Section 3 summarizes the intensive academic debate on the interactions between growth and infrastructure. Section 4 and 5 looks at the thorny question of how much infrastructure is needed to sustain growth levels consistent with poverty reduction objectives, and the efficiency-equity trade-offs that may be associated with the decision of where these investments should be made. This is followed in Section 6 with a discussion of the poverty-related dimensions of the infrastructure access problems. Section 7 and 8 debate the relative role of the private and public sector in infrastructure, focusing on the main institutional changes observed in the last 10-15 years and on their implications for the effectiveness of service delivery. Section 9 concludes.

The State of the Infrastructure Sectors

Many of the issues to be discussed in this paper are anchored into a basic problem: the insufficient stocks of infrastructure and hence the insufficient flows of associated services. To give a sense of this gap, Table 1 provides a quantitative snapshot of the sector based on the latest data available on the service coverage provided to populations in each sector for country groupings reflecting their income levels. The main observations that can be made are obvious: (i) access remains shockingly low in poor countries, despite the donor funded efforts of the last decades and, (ii) we are remarkably ignorant of how well or badly the sector is doing.

The big picture²

First, the levels of access to infrastructure services are, as expected, strongly correlated with a country's average income. Upper middle income countries have the highest access rates (in the developing world) and are very close to meeting the infrastructure needs of all but 10% of their population. The lowest income countries are very far from meeting those needs, in particular in terms of electricity.

Second, progress in achieving full coverage varies significantly across sectors. It has been reasonably good in water and in telecoms (driven, in the case of telecoms, by the

² For a fuller discussion of the evidence on access, quality and prices in infrastructure, see Estache and Goicoechea (2005)

technological revolution that has lowered costs and made service possible even in relatively low density areas). Sanitation continues to be a problem but it is attracting increasing attention as a result of growing interest in environmental problems. Somewhat surprisingly, the biggest problem is the energy sector. The absence of a widely available meaningful indicator for transport precludes it from being included in this comparison.

Table 1. Access to utilities services, by sector

Country Income level	Percentage of population with access to networked electricity (2000)	Number of fixed & mobile telephone subscribers per 1,000 people (2005)	Percentage of population with access to improved water sources (2005)	Percentage of population with access to sanitation (2005)
Low	31	114	75	61
Lower-middle	82	511	82	77
Upper-middle	87	901	94	91
Developing	58	523	83	80

Source: World Development Indicators 2007

If one considers Table 1 as a baseline from which progress from reform could be measured, the challenge is not a modest one. While the international community has been increasingly concerned with the importance of infrastructure needed to generate the investment that will generate growth — as illustrated by the results of investment climate surveys - this table suggest that it would be a major mistake to ignore household need. Indeed, the political sustainability of infrastructure reforms depends on household needs being taken into account as the experience of Latin America demonstrates (see Fay and Morrison 2007 for a discussion).

The challenge is not a minor one for the international donor community, but it is one that is increasingly being recognized. Commitments to improve access rates to water and to some extent to telecommunications have been formalized through the MDGs. The commitments to electrification have been added as part of the Johannesburg Declaration but much less progress is being made on that front. No similar collective commitment exists for the transport sector. Overall, progress in being made, but implementation is slow so that in many countries, the goals are not being met.³

The big holes in the big picture

Somewhat surprisingly, Table 1 summarizes most of the information available to policymakers. The remaining data available on these sectors tends to focus on technical dimensions. Some is policy relevant (e.g. power generation capacity) but much is too specific to technical issues. As compared to the information available on health or

³ For a discussion of the countries and sectors for which the MDGs are unlikely to be met, see World Bank (2005a)

education for instance, the information gap the infrastructure sector faces is huge and shows no sign of narrowing.⁴

On transport for instance, very little information is available on what could serve as a reasonable baseline to assess the economic or social performance of the sector. We know for instance that road density in the poorest developing countries is about a third what it is in the richest developing countries and about a sixth what it is in developed countries. However, this data does not capture the quality or even dimension of the infrastructure and gives the same weight to a one-lane rural road, and a 12 lane ring-road. The heterogeneity in what the stock data measures may well be the worst for roads.

Similarly, on energy, most of the information available on access rates is based on extrapolations from a small sample of representative countries. The last time it was conducted by the International Energy Agency on behalf of the international community was in 2000. Household surveys provide additional information but there are major compatibility issues. Anyone interested in information on prices or quality in the sector will have to work with heroic assumptions to try to generate some credible comparable cross-country datasets.

The situation for water on access is somewhat better to the extent that the UN anchored Joint Monitoring Program has managed to generate some degree of continuity and consistency in the monitoring of progress—although their data sets also rely on some controversial assumptions and extrapolations.

The only sector for which a reasonably good picture can be generated is the telecoms sector, thanks in large part to the efforts of the International Telecommunications Union. Unsurprisingly, this is the sector that has attracted the most interest among academics. Research goes where data is, not necessarily where problems are!

The problems with the monitoring of access rates may surprise many. Even more surprising is the failure to monitor progress in the affordability and quality of these services – dimensions that should be part of the baseline needed to track progress, particularly as regards poverty. This information is unavailable in most developing countries. Most of the related information published is anecdotal, and cross-countries comparisons are often not meaningful, because definitions for quality standards and service pricing practices vary significantly across countries.

An ideal baseline would also include information on the cost of the sector. This is particularly important in view of the size of the projects and of the associated financial transactions. Comparable cost data in infrastructure are largely unknown in this sector in developing countries. As such the frequently heard policy message urging policymakers to improve cost recovery because it costs too much to the taxpayers is seldom based on an accurate estimate of the cost-recovery tariff or its affordability to poor households.

⁴ Living Standard Measurement Surveys (LSMS), Demographic and Health Surveys (DHS), and household consumption surveys do not really provide the required data to address the issue well. First, the sector is generally not well covered in these surveys. Second, there are significant differences in the quality of the data available for urban and rural areas.

Moreover, the cost to taxpayers is seldom known. Recent work on quasi-fiscal deficits represents a rather heroic approach to come to grip with this issue (Ebinger 2006).

As to data on public spending on infrastructure, they are largely non-existent as very few countries estimate how much they spend on infrastructure (one exception is India) and the IMF's Government Financial Statistics do not collect this information. A world wide database exists that compiles information on investments funded through projects that involve a private-public partnership but it has its limitation (see <http://ppi.worldbank.org/>).

The upshot...

There is a long way to go still in meeting the infrastructure needs of the poorest countries of the world. The MDGs help in motivating the efforts to address some of them or at least in prompting the international community to monitor progress. This is not the case for energy and transport since they are not part of the core MDGs. As a result, the commitments to monitor progress are more subdued and certainly not consistent with the importance of these sectors to growth as discussed in the next section. On the other hand, the critical importance of both energy and transport to the climate change agenda might provide a welcome impetus to collect better information and monitor progress. The accountability of governments, operators and donors requires a lot more information than is currently available. To get things done, measurement is needed. This starts with a good baseline and for now, this only exists in the telecoms sector.

How much do we know on the infrastructure-growth nexus?

Common sense suggests that modern economies cannot function without infrastructure and that infrastructure is a critical part of any economy's production function.⁵ But common sense is not equivalent to evidence when it comes to assessing differences in countries' or regions' growth paths. Even if infrastructure is necessary for modern economies to function, it may not be the case that more infrastructures cause more growth at all stages of development or at any for that matter. Maybe the binding constraints lie elsewhere – in poor incentives or missing markets for example. What follows reviews some of the reasons why considerable disagreement remains as to whether infrastructure accumulation can explain countries' differing growth path

A slow convergence of views

Infrastructure may affect growth through many channels (see Agénor and Moreno-Dodson 2006 for an overview). In addition to the conventional productivity effect, infrastructure is likely to affect investment adjustment costs, the durability of private capital and both

⁵ Absent or unreliable transport, electricity or telecom services imply additional costs for firms or prevent them from adopting new technologies. Better transportation increases the effective size of labor markets, and various micro studies suggest an impact on human capital of access to water and sanitation (via health) and electricity and transport (that facilitate access to schools and the ability to study) (Brenneman 2002). Finally, relative infrastructure endowments will affect a region's comparative advantage, hence its development (Estache and Fay 1997).

demand for and supply of health and education services. Many of these channels have been tested empirically. This is reflected in the wide variety of findings in the now abundant empirical literature on infrastructure and growth or productivity. Indeed exhaustive reviews of the literature (Romp and de Haan 2005; Straub and Vellutini 2006, Briceño et al 2004, Gramlich 1994) show that while some authors find negative or zero returns, others conclude to a high impact of infrastructure on growth.

However, a more careful analysis of the literature shows increasing consensus around the notion that infrastructure generally matters for growth and production costs, although its impact seems higher at lower levels of income. Romp and de Haan (2005) note that of 32 of 39 studies of OECD countries found a positive effect of infrastructure on some combination of output, efficiency, productivity, private investment and employment. (Of the rest, three had inconclusive results and four found a negligible or negative impact of infrastructure). They also reviewed 12 studies that include developing countries. Of these, nine find a significant positive impact. The three that find no impact rely on public spending data which – as discussed below- is a notoriously imprecise measure especially for cross-country analysis. Other meta-analysis also report a dominance of studies that conclude to a generally significant impact of infrastructure particularly in developing countries. Cesar Calderon and Luis Servén report that 16 out of 17 studies of developing countries find a positive impact as do 21 of 29 studies of high income countries.⁶ Briceño et al (2004) carry out a similar review of about 102 papers and reach similar conclusions.

Nevertheless, there remains tremendous variety in the findings, particularly as to the magnitude of the effect, with studies reporting widely varying returns and elasticities. In other words, the literature supports the notion that infrastructure matters but it cannot serve to unequivocally argue in favor of more or less infrastructure investments.

The variety of findings is, in fact, unsurprising. There is no reason to expect the effect of infrastructure to be constant (or systematically positive) either over time or across regions or countries. Furthermore, estimating the impact of infrastructure on growth is a complicated endeavor, and papers vary in how carefully they navigate the empirical and econometric pitfalls posed by network effects, endogeneity, heterogeneity and very poor quality data.

The more, the merrier (network effects)

Infrastructure services are mostly provided through networks, a fact that implies a non-linear relation with output. Telecom exhibits “pure” network externalities whereby returns to users increase with the number of users.⁷ But roads, rail, and electricity are also networked services so that the impact of new investments on growth, output or firm costs will depend on the overall state and extent of the network (see Romp and de Haan 2005 for a discussion). In other words, the marginal and average productivity of investments are likely to differ significantly and the hypothesis of a constant or linear elasticity of output with respect to infrastructure is clearly incorrect.

⁶ Personal communication relating to work in progress.

⁷ The same can probably be said of water and sanitation networks where the public health value of safe water and sanitation systems are likely to increase the more individuals are served, in a kind of herd-immunity effect.

A few authors have explicitly modeled the non-linearity of infrastructure's impact on output, growth, or production costs. Thus, Roller and Waverman (2001) find that the impact of telecommunication infrastructure on output is substantially higher in countries where penetration approaches universal coverage. In the case of roads, Fernald (1999) looking at the US found that returns to investments were very high up to the point when the basic interstate network was completed. He argues that the completion of that network provided a one time boost in US productivity.

Threshold effects in infrastructure can be modeled in a variety of ways – through a measure of completeness of coverage as discussed above, or more simply through some measure of income as in Canning and Bennathan (2000). Hurlin (2006) develops a threshold model whereby the level of available infrastructure is the threshold variable but the number and value of the thresholds are endogenously determined. Applying this to the multi-country panel data set of Canning and Bennathan (2000), he finds strong evidence of non-linearity and concludes that the highest marginal productivity of investments is found when a network is sufficiently developed but not completely achieved.

The effect of infrastructure may well also vary over time as other changes in the economy influence firms' abilities to take advantage of it. Thus, in Chile, Albala-Bertrand and Mamatzakis (2004) find that infrastructure's productive impact became much more pronounced after 1973, when the Chilean economy liberalized.

In sum, appropriate modeling of infrastructure's effect on growth must include non-linear effects. If network externalities are not properly captured, the payoffs to infrastructure investments will be under- or over-estimated. Variables likely to affect this are the stage of development of the network and by a number of institutional variables such as the degree of liberalization of the markets and of competition across sub-sectors that will affect the quality of the overall network.

Does infrastructure drive growth or vice versa? (Endogeneity)

Many authors have highlighted the fact that causality may run both ways between income and infrastructure. Indeed, most infrastructure services are both consumption and intermediate goods and many studies have documented that electricity consumption and demand for telephones and cars increase along with disposable income (Chen, Kuo and Chen 2007, Ingram and Liu 1999, Roller and Waverman 2001).⁸ Similarly, countries tend to increase their investments in environmental amenities as they become wealthier. Even studies that rely on constructed TFP estimates (whereby the dependant variable, TFP growth is by construction orthogonal to capital) may well still suffer from reverse causation if growth then influences decisions to invest in infrastructure (see Straub and Vellutini 2006 for a discussion).

⁸ The extent of reverse causation may well vary across types and measures of infrastructure. For example, road networks that are long lived and slow to change are perhaps less likely to respond to changes in income (particularly in countries that already have a large network and where changes to cope with congestions – more lanes, better traffic management, ring roads etc.- will not substantially affect aggregate measures such as km of roads per capita). Not so with telephones or electricity generating capacity (which responds to energy demand whose income elasticity has been around 0.5 since 1990 according to International Energy Agency 2006).

It may also be the case that a common factor causes both higher income and higher infrastructure endowment. Indeed, most of the critique of Aschauer's 1989 work (which launched the infrastructure and growth debate with its findings of implausibly high rates of return) centers on a failure to appropriately correct for the possibility that an omitted variable is driving the results. Indeed, later papers (see Gramlich 1994 for an overview of this literature) correct for this by introducing country (or region) fixed-effects and found much lower rates of return. However, the fixed-effect approach precludes looking at the impact of other slow moving variables which is why a number of authors prefer not to use it (e.g. Estache, Speciale and Veredas 2006).

An alternative approach is to try to isolate the impact of changes in infrastructure on long-term growth, typically by using first-differences. This approach generates its own set of problems. Indeed, first-differences ignore the long-term relationship that exists in the data if infrastructure and growth are co-integrated (which Canning and Pedroni 2004 find to be the case).

One exception is Calderon and Serven (2004) who also take pains to deal with the endogeneity of the explanatory variables through the use of GMM techniques.⁹ They find that a one standard deviation increase in the index of infrastructure stock they use would raise the median country's growth rate by 2.9 percentage points, whereas an analogous increase in their infrastructure quality index would raise the growth rate by 0.7 percentage points. They do point out, however, that such increases in infrastructure quantity and quality would be extremely costly and would take decades to implement. To give an example, the growth payoff for Argentina and Mexico of catching up to the level and quality of infrastructure of Korea would be 2.4% and 2.6% respectively, but would require these countries to invest upwards of 7% per year for over 20 years (World Bank 2005b, 2007). It may well be then that - as discussed later in this section - the fiscal distortion associated with such an effort, and the trade-offs it would entail with other needed investments would substantially reduce the net growth effect.

A number of studies also devise estimation methods that make clear which way the causality runs (see Romp and de Haan for a discussion). Two papers that illustrate this approach are Fernald (1999) who uses industry level productivity growth in the US to measure the impact of road investments, and Canning and Pedroni (2004) who find robust evidence that causality runs both ways but that in the vast majority of cases infrastructure does induce long run growth effects (although they do find a great deal of variation across individual countries as discussed below.)

Finally, a number of authors rely on simultaneous equations systems that look at the determinants of supply of (and/or demand for) infrastructure as well as its impact on output or growth. Roller and Waverman (2001) and Esfahani and Ramirez (2003) are good examples of careful attempts in this direction. Esfahani and Ramirez's paper is also one of the few that uses first differences, and models both income per capita growth and infrastructure accumulation.

⁹ Note that they look at the impact of the *level* of infrastructure (not its change) on subsequent growth.

In sum, infrastructure causes growth and growth causes greater demand for (and usually supply of) infrastructure. While disentangling the two is complex, new econometric approaches increasingly allow us to isolate the direction of interest and thereby reduce the over-estimation issues that plagued early estimates of infrastructure's impact on growth.

Is every infrastructure project special? (Heterogeneity)

In the case of non-infrastructure capital, private entrepreneurs arbitrage between different types of investments to maximize overall return. Not so with infrastructure: it is generally not faced with a real market test. As such, we cannot assume that the right capital is built at the right time or place and we should therefore expect differences in rates of return across different projects. In addition, public infrastructure spending may be affected by public sector spending inefficiency. As a result, while financial estimates of investment in private capital may be a good proxy of the increases in private physical capital and may serve as the basis for constructing a stock figure through a perpetual inventory method, this is much less likely with infrastructure.

More generally, there is also a need to better understand how decisions are made to invest in infrastructure as this is likely to affect the rate of return or the efficiency of a particular investment. (It may well also help identify ways of improving infrastructure expenditure efficiency). Politically motivated projects are likely to exhibit low (or lower) rates of return as their objectives are to bring in the votes rather than to maximize growth. This is certainly not limited to developing countries as evidenced by the controversies around "Alaska's bridges to no-where" in the United States.¹⁰ Similarly, a recent careful attempt to model how investment decisions are made in France concluded that "roads and railways are not built to reduce traffic jams; they are built essentially to get politicians elected" (Cadot et al 2006 p1151).¹¹

While some degree of pork-barrel politics is likely to exist everywhere, its extent and impact may vary. De la Fuente and Vives (1995) found little trace of political influence in Spanish infrastructure decisions, while Cadot et al find it in France. However, Cadot and his co-authors conclude that in France the resulting distortions are small, possibly because this is a relatively new phenomenon (linked to administrative reforms in the early 1980s) that has mostly affected investments that are small relative to the existing network.

A further complication in the modeling – and one that argues against a constant expected rate of return – is the fact that there may be lags in infrastructure's impact on growth. Most infrastructure is long-lived, and it could be that its full impact is slow in coming as firms adjust slowly to the new opportunities offered. Duggal et al (2006) find the productivity impact of increased IT infrastructure and associated private capital to have an approximate 4 to 5 year lag in the US.

¹⁰ Alaska's famous \$280 million "bridge to nowhere" that was one of the 6,371 special projects included in the 2005 US Transportation Equity Act (a six-year \$286 billion bill). See http://dir.salon.com/story/news/feature/2005/08/09/bridges/index_np.html for a discussion.

¹¹ Other papers on the political economy guiding infrastructure investment decisions include Rauch 1995, Robinson and Torvik (2005) and Alesina, Baqir and Easterly (1999).

Overall, even if not pork, public infrastructure investment may well have a non-economic objective such as the physical or social integration of a country, or follow public health or safety concerns. As such, the investment may not aim to maximize growth. At any rate, careful modeling of the relation between infrastructure and growth should include an analysis of the determinants of infrastructure investments to avoid overestimating the growth or productivity related investment needs.

The upshot...

The literature on infrastructure and growth teaches us that infrastructure is important but that its importance varies. It varies across countries, and over time, as countries change and the binding constraints shift. It also varies within countries and sectors. Can it explain differences in growth rates between countries? It certainly contributes but this literature is unlikely to provide a single answer. So, where do we go from here?

How much infrastructure is needed?

The key infrastructure question for policymakers is often whether an optimal level of infrastructure can be identified. Such an optimum could then serve to derive the investment commitments needed, for which funding must be identified. More prosaically, the concern boils down to a simple question: can we estimate a country's infrastructure investment needs?

A very brief introduction to investment needs assessments recipes

Given that neither the market nor the state is likely to automatically provide the optimal level of infrastructure, a key question for economists working on the topic is how to measure this optimal level of infrastructure. One strand of answers looks at the rate of return on infrastructure. Thus, studies that find the rate of return to infrastructure to be negative/zero/positive often use these to conclude that countries are investing too much/the right amount/not enough in infrastructure.¹² For example Bougheas, Demetriades and Mamuneas (2000) find an inverted U shape relation between infrastructure and the rate of economic growth, with most countries on the upward sloping part of the curve. This would imply they are under-investing in infrastructure. Esfahani and Ramirez (2003) also conclude to a tendency towards under-provision. Canning and Bennathan (2000) find variation across countries but a general tendency for middle-income countries to exhibit shortages in electricity generating capacity and paved roads. However, while these papers are broadly indicative of whether countries are under- or over-investing in infrastructure, they cannot identify actual investment needs.

One approach that has been extensively used (and mis-used) estimates how much investment may be needed to satisfy firm and consumer demand triggered by predicted GDP growth (Fay and Yepes 2003, Briceño et al 2004). The model assumes no

¹² Note that in empirical studies where both infrastructure and overall capital are included, infrastructure is essentially entered twice, in which case an elasticity estimate no different from zero should be interpreted as infrastructure having the same rate of return as private capital.

optimality.¹³ The relationship between income level and infrastructure service demand is established on the basis of past observed behavior in a sample of countries and extrapolated to the future using predicted income growth. However, as Lall and Wang (2006) point out, if past demand was rationed, and therefore may not be good a predictor of unrationed demand. They therefore argue for an approach that incorporates fiscal constraints and supply-side bottlenecks, and models the gap between current and optimal level of provisions.

Whatever its limitations (and they are severe), the approach developed by Fay and Yepes forms the basis of many of the multi-country investment needs estimates that exist. The most recent estimates generated from an update of the original model are presented in Table 2. They suggest that the needs are large, particularly within low-income countries where the investment needs have been estimated at around 4% of GDP with an additional 4% required for maintenance.

The inclusion of maintenance needs calculated as a fixed proportion of the accumulated capital stock is essential from a practical point of view. The importance of maintenance and the need to budget for it has long been known but it has only recently been documented in the academic literature: Rioja 2003 and Kalaitzidakis and Kalyvitis 2004 highlight the fact that countries tend to under-spend on maintenance, a fact that substantially reduces the useful life of infrastructure assets, hence their rate of return. Maintenance expenditure standards are well-known and result in very predictable annual expenditure outlays when averaged over an entire network. Appropriate, but by no means generous, standards are approximately 2% of the replacement cost of capital for electricity, roads, and rail, 3% for water and sanitation, and about 8% for mobile and fixed lines.

Table 2: Investment and Maintenance Expenditure Needs as % of GDP			
(Average 2005-2015)			
Country Group	Investment	Maintenance	Total
Low Income	4.2%	3.3%	7.5%
Lower Middle Income	3.8%	2.5%	6.3%
Upper Middle Income	1.7%	1.4%	3.1%
Total Developing	3.2%	2.3%	6.5%

Source: courtesy of Tito Yepes, based on Fay and Yepes (2003)

The estimates provided in Table 2 serve as a rough benchmark for different country types. But they assume standardized unit costs and ignore many country and regional specificities. When looking at a particular country, these macro-estimates should be complemented with other approaches, to allow for some “triangulation.”¹⁴ However, these will require the definition of a set of goals – which may be motivated by economic, engineering, social,

¹³ The model identifies potential demand given expected growth, not the level of infrastructure that would maximize growth or some other social goal.

¹⁴ The process of estimating investment needs is so fraught with assumptions, uncertain data, etc. that it is only common sense to rely on various approaches to generate a series of estimates. To the extent that the estimates appear to converge there can be more confidence in the recommendations that emerge.

environmental or public health concerns. Societies may also differ on the level of services that is deemed appropriate.¹⁵ Table 3 illustrates the various ways in which the goals may be set this using the example of Mexico, where this exercise was undertaken in the context of a public expenditure review focused on infrastructure.

The gold-plate version of country-specific “investment needs” analysis relies on sectoral micro studies. The approaches and methodologies vary depending on the sectors. In the case of electricity, sophisticated economic-engineering models can be used to estimate the investments required to maintain the integrity of a network facing demand expansion.¹⁶ These allow sector specialists to provide various sets of estimates depending on whether basic reliability of a system is pursued, or whether the goal is high quality and reliability. In the transport sector, the approach is usually more ad-hoc and relies on a combination of sector specialists’ estimates and detailed studies (particularly on the needs for upgrades or expansions). In the case of water and sanitation, the connection cost of universal coverage is easy to estimate, based on standard prices. However, the cost of associated works is much harder to establish and there is usually no simple way of estimating rehabilitation needs.

Table 3: Different approaches to estimating expenditure needs in infrastructure—the example of Mexico

	“Benchmarking”	Set target
Costing exercise	<p>Ex:</p> <ul style="list-style-type: none"> - Stock target: what would it cost to get Mexico’s infrastructure (per capita; per unit of GDP; per km2) to the level of the LAC leader; or to the level of the East Asia median? - Flow target: how does Mexico’s expenditures on infrastructure compare to peers. 	<p>Ex:</p> <p>What would it cost for Mexico to achieve universal service coverage in water and sanitation, electricity, and access to year-round roads?</p>
Model	<p>Econometric:</p> <p>Growth: What level of infrastructure coverage is needed to achieve x% level of growth and reduce inequality by z%. No such model available yet.</p> <p>Demand: What level of infrastructure coverage will be demanded by firms and consumers, for given growth projections. This is the approach followed in Fay and Yepes (2003).</p>	<p>Engineering-economic models:</p> <p>These are “set” targets inasmuch as the target is a particular level of coverage and quality as defined through engineering-economic models</p> <p>Power sector: well-defined international methodology, applied by CFE in Mexico, which estimates the investment needed to maintain the integrity of the network and satisfy predicted expansion in demand.</p> <p>Water/sanitation: financial model that estimates investment needed to attain the coverage goals set in National Hydraulic Plan.</p>

¹⁵ An interesting example is given by the case of the Eastern and Southern Europe now joining the European Union. These countries are required by the accession agreements to pursue a quality of water and sanitation services that was reached in the city of Brussels only in the last few years. However, given that these countries have an income per capita much below the EU average, such a high level of service quality represents a huge financial burden (the cost has been estimated at around Euro 9 billion for Romania equivalent to 16% of its 2004 GDP) and is therefore being subsidized by the EU. Questions remain however, as in other EU accession countries, about the affordability of the maintenance of these sophisticated systems.

¹⁶ Mexico uses the Wien automatic system planning package (WASP IV), a widely used model that analyzes generating system expansion options, primarily to determine the least costly expansion path that will adequately meet the demand for electric power, subject to user-defined constraints. Other similar models are SUPER/OLADE/BID and MPODE, which are used by Colombia and Ecuador, for example.

Roads: well-defined methodology for rehabilitation and maintenance expenditures; combined with road sector expert opinion on definition of major corridors and investment needs for their completion.

Source: World Bank (2005b)

But even sophisticated sectoral studies can turn into unrealistic wish-lists. It is useful therefore to do some simple benchmarking. This can entail comparing a country to its peers (as defined, say, by income levels) or to a country that offers a promising example (say, a newly industrialized country such as the Republic of Korea), and asking how much it would cost to achieve the service coverage or quality of the comparator country. The comparison can be on the basis of coverage or quality or of expenditure flows.

There is usually a need to include additional provisions for social objectives as well as maintenance. Social objectives may be the ones defined in the Millennium Development Goals or universal coverage.¹⁷ For middle income countries, this is usually a small proportion of the overall tab, at least for bare-bone coverage that may not include grid connection. For low-income countries, where both coverage and income are low, the costs can be very high.

What if budget constraints affect the optimal level of infrastructure?

The problem with the approaches described above is that the optimal level of infrastructure provision cannot be divorced from how it is financed. And there may be a trade-off between increased infrastructure and increased taxes. In fact, Aschauer (2000) finds that the level of public *capital* in most US states was below the growth maximizing level in the 1970s and 1980s, although public *expenditure* was too high (leaving open the question of what is the optimal balance between the two).¹⁸ Kamps (2005) who applies the same model to EU countries argues that the distortion associated with taxation discourage private investment.

How much then should countries be spending on infrastructure given competing needs for public spending, fiscal constraints and limited ability to charge users? One approach is to develop a general equilibrium model that explicitly incorporates public investment costs and solve it for infrastructure. Rioja (2001) does this for Brazil, Peru and Mexico, and identifies an optimal (defined as growth-maximizing) level of infrastructure, health and education spending. However, this study, like others of the kind (e.g. Cavalcanti Ferreira and Gonçalves do Nascimento 2005 and Estache and Munoz 2007) relies on parameters of elasticity of growth with respect to infrastructure estimated in other studies – which may or not be accurate.

Theoretically, Aschauer's 2000 model could be used to calculate the growth - or welfare-maximizing level of infrastructure spending. However, it also requires an estimate of the

¹⁷ The one original Millennium Development Goal pertaining directly to infrastructure is to "halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation" although electrification has now been included

¹⁸ Rioja 2001 develops a general equilibrium model which explicitly models public investment's resource cost and which he solves to show the optimal level of infrastructure for three countries: Brazil, Peru and Mexico.

elasticity of output with respect to public capital (which he sets to 0.3 for the US). Kamps actually calculates this elasticity for EU countries, but then constrains it to be constant and equal across countries (in his case at 0.2). One option could then be to apply Aschauer or Kamps' methodology to estimate growth maximizing stocks of infrastructure (this would require calculating country/infrastructure specific elasticities something the preceding discussion showed to be non-trivial). The cost of reaching, or maintaining the optimal stock level could then be estimated using either country specific or international prices for these stocks.

So which way to go with this literature? Lall and Wang (2006) offer a promising way forward although their model has not yet been empirically estimated and require a more complete modeling of infrastructure supply decision. It also remains a partial equilibrium analysis. Similarly, the Aschauer (2000) or Kamps (2005) models may well offer the basis for an interesting alternative. However, good data on the cost of infrastructure provision is required to translate that into investment need figures and put them in the perspective of the available fiscal space.

The upshot...

Deciding how much should be spent on infrastructure is clearly not an easy exercise. But it needs to be done and can offer basic benchmarks. The literature offers some guidance although there is a long way to go still before the various approaches will generate lower and upper bounds that converge towards a robust assessment of needs – and one that accounts for the fact that infrastructure competes with other sectors for scarce resources.

Where should infrastructure investments be made?

With the re-emergence of economic geography, infrastructure needs are being examined with a spatial twist: the question is no longer simply “how much” but also “where”. The answer to that second question is even more problematic than the first, for two reasons. First, the most promising research is for now mostly theoretical. Second, spatial development policies debates are often politically charged, with advocacy often prevailing over rationality (as witness the older urban bias debate).

An introduction to the relevance of the new geography economic to infrastructure

The “where” question is being addressed in an emerging strand of literature that has little empirical evidence to draw on, at least for developing countries. The new economic geography literature (see Baldwin et al 2003 for an overview) suggests that infrastructure will interact with physical characteristics to affect the comparative advantage of a region, hence its growth and a country's settlement patterns. Puga (2002) offers a nice overview of the arguments and the evidence, particularly as they pertain to transport, which we summarize below.

Infrastructure, particularly transport, is seen by most policy-makers as critical in efforts to help disadvantaged regions become more attractive to investors: improved connectivity is

usually seen as a key to allowing peripheral regions to better integrate the domestic or international economy.

The impact of improved transport on a backward region is ambiguous however, as it may remove a natural trade barrier that was protecting local industries and thus contribute to further concentration of employment in the advanced region. This is particularly likely within a country where wage differences are unlikely to be significant. Indeed, in France improved transport links has led to the concentration, rather than to the dispersion of employment (Combes and Lafourcade 2001). In Italy, Faini (1983) has argued that the reduction in transport costs between the North and the South led to the de-industrialization of the South.

However, de-concentration within metro-areas from the core to the periphery does happen with transport improvements. For example, Henderson et al. (1996) show that many firms moved out of Jakarta to the peripheral areas of the Greater Jakarta metropolitan region in the mid 1980s. These moves were facilitated by the construction of toll-ring roads around the city, retaining some agglomeration benefits of the region, but reducing congestion costs (e.g., land rents and transport costs), enabling firms to benefit from lower land and labor costs in the periphery which exceeded the increased costs of transport serving the same market.

Similarly, in Brazil the deconcentration of industry from Greater Sao Paulo to lower wage populated hinterland cities followed the transport corridors first through Sao Paulo state and then into Minas Gerais, the interior state with the main iron ore and other mineral reserves (Henderson et. al 2001). But even if improved inter-regional transport network in Brazil had significant productivity impacts and greatly contributed to the prosperity of states and towns at the periphery of the traditional economic core, it did not lead to industrialization in more remote, lagging areas (Lall, Funderburg and Yepes 2003).

Location theory suggests that the nature and structure of a transport project will affect its impact on the local economy. Thus improving local – as opposed to inter-regional – infrastructure is much less likely to harm the local economy. Similarly hub-and-spoke networks encourage the concentration of activity in the hubs as firms located there face lower transport costs than firms in spokes (Puga 2002).

Inter-regional networks will of course bring benefits to peripheral regions. However, the gap in relative accessibility will widen between central and peripheral regions, even if the biggest absolute gains occur in the remote areas. This point is well illustrated in Europe for high speed train (Vickerman et al 1999 in Puga 2002). It is also what explains the lack of impact of the national highway network on Brazil's North East discussed earlier (Lall, Funderburg and Yepes 2003).

Transport infrastructure simply isn't a silver bullet for regional development. Nevertheless, the empirical work quoted above - and much anecdotal evidence - suggests that infrastructure investments are likely to be necessary if non-sufficient for regional growth. Access to all weather roads, reliable telephony (e.g. through cell phones) and electricity is a pre-requisite to allow rural areas to produce higher value processed goods.

And regions cannot export if their transport network results in excessively high costs (Iimi 2007). But what will matter is the interaction between these investments and other factors that determine a region's comparative advantage and its ability to market it.

Project selection may also follow a goal of balanced regional development. In that case the result may not be a (national) growth-maximizing investment (although it may well be welfare-maximizing). Targeting investments towards poorer regions may therefore entail equity/efficiency trade-offs. This is documented in the case of Spain, by various studies by de la Fuente (2002a, 2002b) who finds that substantial investments in the poorer regions did result in convergence in income but at the cost of overall national growth.

Investing in rural or in urban areas?

In most countries, much of output and growth is generated in cities, and today about half the world population lives in cities. Moreover, poor people urbanize faster than the population as a whole.¹⁹ But are these stylized facts sufficient to argue that infrastructure should go mostly to cities?

In most countries the story is much more subtle than urban-rural dichotomies allow. First, the contrast is typically more between leading and lagging regions. Rural population in leading regions, close to booming urban center with strong demand for their goods and the roads and buses to take their goods to market will tend to be more prosperous (and have much better infrastructure access) than rural or urban dwellers in lagging regions. So this brings us back to the earlier debate on balanced regional development. Second, in some regions (Africa, South Asia) the population remains mostly rural and will remain so for some time. Indeed, while the poor urbanize faster than the rich, a majority of poor people will still live in rural areas long after most people in the developing world live in urban areas (Ravallion 2002).²⁰

Ultimately, the choice of the priority is really a policy choice that economists can only serve to inform. In particular, economic work can help in identifying some of the equity-efficiency trade-offs as well as the channels through which investments may affect local prosperity and well-being. In particular, there is wide agreement that infrastructure in rural areas can improve agricultural productivity and reduce rural poverty.²¹ Similarly, there is substantial evidence to show that infrastructure can reduce urban poverty (Henderson 2002).

General equilibrium modeling can help identify the distributional impact of infrastructure reform, notably their differing consequences for urban and rural populations. Reforms tend to unbundle the urban and rural responsibilities of operators, ending historical cross-subsidies and forcing choices for more targeted subsidies to system expansions. Boccanfuso et al. (2006) for instance, show that water reforms in

¹⁹ See Ravallion (2002) and Cohen (2004) for a discussion of population trends.

²⁰ This is not a new debate. Almost 30 years ago, Lipton (1977) and Mellor (1976) were concerned with the opposite question: was the urban bias of the international community rational?

²¹ See Reardon (2001); van de Walle and Nead (1995); Lanjouw (1999); Jacoby (2000); van de Walle (2002); Gibson and Rozelle (2002); Renkow, Hallstrom, and Karanja (2004); Lokshin and Yemtsov (2005).

Senegal have had a very different initial impact in the capital city, secondary cities, and rural areas. They also show that unless interregional cross-subsidies are an option, most common cost-recovery financing policies will have different consequences for the poor in regions that have different provider type (that is, large public, large private, or small private).

A particularly interesting analysis of the differing impact of infrastructure investments between rural and urban poor comes from Adam and Bevan (2004). They show that infrastructure investments in Uganda that support tradables have different impacts on the distribution of poverty between rural and urban areas as well as on the real exchange rate and other macroeconomic variables. When infrastructure investment favor tradables (e.g. telecommunications or energy, which tend to enjoy a much stronger demand from manufacturing and services than transport), the real exchange appreciation is strongest. When it is biased toward nontradables (for example, rural and urban roads), there is hardly any change in the real exchange rate. The main difference between the two scenarios is a distributional one. Support to tradables helps all income classes; support to nontradables helps the urban poor and, somewhat counter intuitively, hurts the rural poor, if population migration is ignored. The rural poor gain from more access to food, but they lose from the lower income they receive from food production. This loss is greater the more the infrastructure aid is biased toward nontradable goods.

The upshot...

Deciding where to invest is as hard or harder than to decide how much to invest. Reduced transport and communication costs will favor additional trade, additional mobility and possibly additional demand for skilled workers in many of the developing countries. But to get there, some tough decisions need to be made on the location of investments. The trade-offs are much more complex than often recognized, although recent work such as Adam and Bevan's can help understand them. However, we have little understanding of dynamic impact of infrastructure investments on rural or urban economies or their integration. Continued empirical work on the topic will help the new economic geography literature become increasingly relevant for policy-making.

Are the infrastructure needs of the poor being met?

Infrastructure policy failures are typically hardest on the poor. First, the failure to provide for universal access has of course hurt the poor most. Second is through the failure to come up with tariff designs consistent with the poor's cash flows and ability to pay. The MDGs have helped somewhat in putting the access problem on the agenda. The strong voices of discontent with the privatization experiences, in particular in Africa, Latin America and to a lesser extent Eastern Europe, have highlighted the affordability problems.

How bad is the access problem for the poorest?

Table 1, presented earlier and summarizing the average access rates per country groups, hides the extent of hardship endured by the poorest population.²² Table 4 (generated from Briceño and Klychnikova 2006) is based on information collected from household surveys rather than from some extrapolation as the country wide average indicators tend to be in energy and water and sanitation. Household survey data have their own limitations but the snapshot they offer provide useful additional information from a policy perspective. In particular, they provide a much better sense of the uneven distribution of the access gaps across income groups at various stages of development. The table shows that gaps between the poorest and richest 20 percent are systematically strongest in poorer countries.

Table 4. Access to infrastructure services by richest and poorest 20 percent of the population (% of population receiving services)								
	Electricity		Water		Sanitation		Telephone	
<i>Country grouping according to Income level</i>	<i>Poorest 20%</i>	<i>Richest 20%</i>	<i>Poorest 20%</i>	<i>Richest 20%</i>	<i>Poorest 20%</i>	<i>Richest 20%</i>	<i>Poorest 20%</i>	<i>Richest 20%</i>
Low	9.7	68.7	41.1	78.5	27.2	68.8	3.2	24.5
Lower-middle	79.5	99.3	64.5	86.6	48.2	78.7	21.2	66.1
Upper-middle	81.4	99.5	76.7	95	73.4	96.4	32	73.1
<i>Source:</i> Briceño and Klychnikova (2006) <i>Note:</i> Data are the most recent available for 2000–04.								

How bad is the affordability problem?

The access gap is only part of the problem. There is also an affordability issue. Infrastructure practitioners rely on rules of thumb to get a sense of the affordability problem in any sector. One such rule of thumb (developed by the World Health Organization) is that households should not need to spend more than 5% of their income on their water and sanitation need—3.5 for water alone. In the case of electricity, there is no such formal ‘rule of thumb’ but many also assume that 4-6% is a maximum to spend on energy. Overall, the more general informal rule is the one that suggests that poor households should not have to spend more than 15% of their income on infrastructure services.

Armed with these rules of thumbs, it should be easy to get a sense of the extent of the affordability problem across the world. It is however impossible, because there is no systematic formal monitoring of this crucial issue. There are however a number of recent books which have documented quite carefully the problem within Africa, Eastern Europe,

²² In the Demographic and Health Survey data, the poorer and richer are defined based on an asset index used as a proxy of the welfare level. In the Living Standard Measurement Survey data, households are ranked by total per capita expenditure.

and Latin America—within the limits allowed by significant data constraints.²³ The main lesson to emerge from that research is that even though the share of household expenditure devoted to infrastructure services, including utilities is only slightly higher in Sub-Saharan Africa than in other regions, the fact that households are so much poorer in Africa than elsewhere makes it more difficult for the population to deal with current costs of service. This is especially the case among those who are not connected to existing networks, because they tend to pay more for their services than connected households. The cost advantage for connected households is due itself in part to existing subsidies (services are often billed at prices below full cost recovery levels) which are very badly targeted again simply because access rates to modern services are so low among the poor.

What can be done to deal with access and affordability problems?

Affordability and access issues were already well-known when the reforms of the 1990s were implemented. But efficiency concerns prevailed over equity or affordability ones. And indeed recent research does suggest that the reforms generally increased efficiency although not equally across sectors and across regions. However, these efficiency gains were not always been shared with users, particularly the poor. Some of the reasons the poor did not always benefit include: tariff rebalancing and restructuring became more efficient but also often more regressive or at least less progressive; increased bill collections de facto increased tariffs; increased quality and reliability were usually accompanied by increased tariff to recover higher service costs; cream-skimming by new operators eliminated cross-regional subsidies, slowing investment programs in the poorest regions when governments could not compensate through increased subsidies; and finally failures to offer payment facilities made it more difficult for the poor to afford new connections.

All this implies that poverty was not addressed carefully in the regulatory and other reform packages implemented during the 1990s. The sad thing is that addressing the needs of the poorest is not all that complex to do. For access there are three basic types of instruments: (a) instrument requiring operators to provide access (a service obligation to avoid unilateral exclusion by the provider);²⁴ (b) instruments reducing connection costs (through cross-subsidies or direct subsidies built into the tariff design or through credit or discriminatory payment plans in favor of the poor); and (c) instruments increasing the range of suppliers (to give users choice, including the option of reducing costs by choosing lower-quality service providers).

For affordability, broadly speaking, all instruments work in at least one of three ways: (a) by reducing bills for poor households (through lifelines or means-tested subsidies based on socioeconomic characteristics or the characteristics of the connection, financed through cross-subsidies or direct subsidies built into the tariff design); (b) by reducing the cost of services (by avoiding granting a monopoly right when it is not necessary or by providing

²³ Estache, Foster, and Wodon 2002 on Latin America for the World Bank; Foster and Yepes (2006) for Latin America, Alam et al. (2005) for Eastern Europe and Estache and Wodon 2007 on Africa; Ugaz and Waddams-Price 2003 and Nellis and Birdsall 2005 on the international experience

²⁴ This issue is not addressed here; interested readers should see Chisari, Estache, and Waddams-Price (2003); Clarke and Wallsten (2002); Cremer and others (2001); Gasmi and others (2002); and Laffont (2005)

an incentive for operators to reduce costs and pass on the cost reductions to users); and (c) by facilitating the payment of bills (by allowing discriminatory administrative arrangements in favor of the permanently or temporarily poor) (Estache and others 2002).

While these recipes may seem obvious, they are not uncontroversial. Subsidies, and in particular, cross-subsidies continue to be seen as undesirable policy instruments in many circles and that bad reputation has tended to spill over in infrastructure for the last 20 years or so. Yet, in spite of their bad reputation, most practitioners will argue that (i) subsidies (direct or not) are needed in most countries and (ii) they are not always as ineffective or distortionary as have been argued.²⁵ These results seem to hold for both temporary and chronic poverty.²⁶

The anecdotal and econometric evidence confirms that subsidies are hard to avoid. According to Foster and Yepes (2006), in the poorest part of Latin America (Bolivia, Honduras, Nicaragua or Paraguay) over 50% of the households would have to pay more than 5% of their income for water or electricity services if tariffs were set at cost recovery levels. In India and Africa, around 70% of the households would have that problem and could be expected to face difficulties in paying full cost recovery tariffs. In these regions, tariffs would likely have to increase by a factor of ten to reach cost recovery levels, making it unlikely that poor households could afford them.

And in many countries, cross-subsidies are the only realistic option given fiscal stress and the limited ability to fund subsidies through general taxes. In most instances, the tariff design aimed at ensure that the usage (after a minimum vital level) is priced at full cost while the amortization of the investment benefits from a subsidy or a cross subsidy.

When general redistribution is not working, redistribution within the sector can be effective. These instruments are clearly not safe bets since well-intended targeting mechanisms have also been regressive as a result of failures to target access, consumption, or both.²⁷ But bad designs are not equivalent to bad instruments.

The upshot

The sheer number of poor without access in many parts of the world and their geographical dispersion are two of the main challenges infrastructure reformers must address. It is unlikely that the poor will be able to afford the cost of reasonable levels of safe consumption of infrastructure services without some fiscal support. When general redistribution is not working, redistribution within the sector can be effective. These instruments are clearly not safe bets since well-intended targeting mechanisms have also been regressive as a result of failures to target access, consumption, or both. But bad designs are not equivalent to bad instruments. Moreover, considering that the users who are connected today most probably benefited from subsidies paid out of general tax revenue during the many years during which the utilities (typically public) were running a

²⁵ For a recent overview of the literature on subsidies of relevance to infrastructure see Komives et al. (2005)

²⁶ For a useful review of the debate and survey of the empirical evidence, see Ravallion (2003).

²⁷ Estache, Foster, and Wodon (2002) show how common this is in Latin America.

deficit, cross subsidies between users is likely to be fair from an inter-generational equity viewpoint.

How large a role for the private sector?

Privatization remains a controversial topic among policymakers. During most of the 1990s, following the lead of the Thatcher experience in the UK and President Menem's in Argentina, trying to get the private sector to be in charge of most infrastructure investment decisions was one of the most popular ideas among economic advisors. The approach seemed particularly attractive to the many governments faced with fiscal constraints, unable to cope with the multiple demands on a shrinking budget or to get public enterprises to cost effectively deliver quality services.

How strong is the presence of the private sector in infrastructure?

A recent survey documents the extent to which the large-scale private sector is present in infrastructure in developing countries. It simply reports the presence or absence of large scale private operators in countries. The information is summarized in Table 5 and three facts emerge. The first is that the sector most effective in attracting the private sector is telecom. The second is that the involvement of the private sector is greater in richer countries. The third is that, even in high income countries, the presence of the private sector is much less widespread than sometimes thought. Only about a third of developing countries can count on private sector operators for the delivery of electricity, water, or railway services. The largest private sector presence is in the fixed line telecommunication sector, where about 60 percent of countries rely on private operators. The private sector is estimated to have only provided about 20–25 percent of the investment realized in developing countries on average over the past 15 years or so.²⁸ In Africa it has contributed to less than 10 percent of the needs and most of this contribution has gone to a fistful of countries (South Africa, Kenya, Ivory Coast, Senegal, Tanzania and Uganda).

Table 5. Percentage of countries with significant large scale private investment in infrastructure (2004)					
Income level	Electricity generation	Electricity distribution	Water and sanitation	Railways	Fixed-line telecoms
Low	41	29	18	34	50
Lower-middle	48	37	50	26	62
Upper-middle	58	48	47	60	72
Developing	47	36	35	36	59

Source: Estache and Goicoechea 2005. Note: Data for railways are from 2002.

²⁸ This number has been arrived at by researchers working independently at the Department for International Development (DFID) and the World Bank (World Bank 2005a). Very roughly, it has been worked out as follows. The overall investment has been estimated using changes in physical capital stocks in countries valued at international prices while the private sector share is estimated based on total commitments made during the same period by the private sector according to the World Bank PPI database. This is likely to be an overestimate, because commitments are not necessarily disbursed (and because these transactions include public funds).

This is not to deny the presence of the smaller scale private sector. In fact, where the state and the large private sector have failed to deliver services, the small-scale, generally local, private sector has filled the gap. The evidence on their role, and details of their costs, is mostly anecdotal, however. In a recent survey, Kariuki and Schwartz (2005) identified 23 African countries where small-scale providers are supplying different kinds of services. For about half of these countries, these small scale providers account for a very large share of water services. Similar information is available for parts of Asia and Latin America. In many countries, small providers are taking the lead in serving low-income households and dispersed populations in rural and peri-urban areas where large scale providers are unwilling to go.

Moreover, increasingly, large scale operators from OECD countries are being replaced by developing country investors who have emerged as a major source of investment finance for infrastructure projects with private participation. The increasing presence of China and India in Africa or Latin America continues to make the headlines in those parts of the world. Schur et al (2006) argue that in 1998–2004 these investors accounted for more of this finance in transport across developing regions—and for more in South Asia and Sub-Saharan Africa—than did investors from developed countries. They show that during that period, developing country investors contributed more than half the private investment in concessions (54 percent), slightly less than half in greenfield projects (44 percent), and a smaller share in divestitures (30 percent). The large majority (29 percent) came from local companies investing in projects in their own country (“developing local” investors); of the rest (13 percent), almost all came from investors from nearby countries.

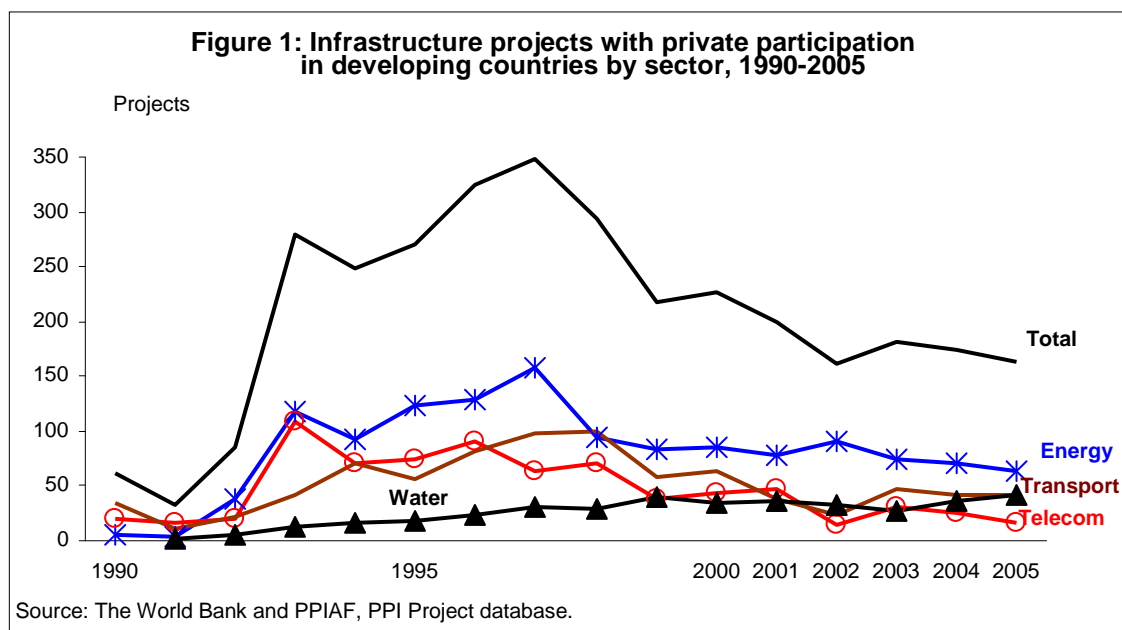
How much private money is actually flowing to developing countries?

There is no information on actual disbursements by private investors in infrastructure. There is however an international database on commitments developed and maintained by the World Bank (<http://ppi.worldbank.org/>) that includes investments associated with management, concession, greenfield and divestiture contracts that have reached financial closure.

According to this commitment data, between 1990 and 2005, private investors committed US\$961 billion through more than 3,200 projects. That is an average of US\$64 billion per year. Figure 1 shows that private participation in infrastructure projects in developing countries peaked in 1996. The Asian crisis launched a broadly declining trend for several years afterward. However, in 2004 and 2005 investment recovered. Throughout the period over 75% of the investment went to the telecoms and the energy sector. Most also went to Latin America and East Asia although in the last 2-3 years, Eastern Europe has enjoyed the highest levels of commitments. In fact, Eastern Europe has driven most of the recovery on commitments to private infrastructure projects. Africa and South Asia continue to be only very modest beneficiaries of these types of investments.

To put things in perspective, it should be noted that in the 2000-2005 period these investments amounted to 0.85% of GDP for lower and upper middle income countries and about 0.69% for the least developed countries. This is not minor but considering the ranges of investment needs discussed earlier, PPI then amount represent only 10% of those

needs for the poorest countries and about 25% for the richer developing countries. In other words, if the 25% is viewed as a benchmark, improvements in the investment climate for infrastructure investors and operators could generate more than a doubling of the private investment currently seen in the poorest countries. To sustain the growth rates needed to reduce poverty, it is essential however to ensure that private investment does not crowd out public investment as often happened. During the 1990s in Latin America and Africa, many government (and donors) slowed down their investment in infrastructure on the assumption that the private sector would more than compensate. It turns out that the net effect on investment in the sector was negative.



It may be useful to point out also that in all sectors, with the exception of the water sector maybe, there has been a difference in efficiency between the public and the private operators.²⁹ In general, private operators have been more efficient which implies that the users and the taxpayers can potentially benefit more from the private operation of the services. However, the level of efficiency and the distribution of the gains achieved from these better efficiency levels have however been driven by the quality of the regulatory environment. The experience on that front has however not been very good as discussed later in the paper.

What drives the participation of the private sector?

The participation of the private sector depends on many dimensions. Exchange rate risks, commercial/demand risks, regulatory risks and political instability can all be very damaging. These risks are typically accounted for in estimates of the minimum rate of return that private operators want from a deal in a given country. Ignoring for now the strategic motivations that may lead an operator to enter a country even if the returns on a specific transaction are not high, most Anglo-Saxon and Nordic, and increasingly the

²⁹ For a very recent overview see Gassner et al (2007)

analysts anchored in other traditions to identify business models or options believe that estimates of the cost of capital associated with a transaction can be a good approximation of the expected minimum return.³⁰

Several recent articles estimate this cost of capital for the various sub sectors.³¹ These estimates suggest that the returns required starting a project in lower-income countries have to be at least 2–3 percentage points higher than in richer developing countries and more than twice what is generally expected in developed countries in infrastructure activities.³² The average ex-post rates of return for the large OECD operators who lead many of the privatizations of the last 15 years have so far often been below this cost of capital, in particular in Eastern Europe and in Latin America.

These results explain fairly clearly why the large scale western private sector is increasing where the public sector is coming back strongly to operate utilities. Even when these private operators continue to operate, they rely significantly more on high cost debt rather than on equity to finance the investments. These numbers imply that, all non-financial conditions being equal, the average tariff necessary to generate the minimum required rate of return in the poorest developing countries has to be higher than elsewhere and is increasing, because it needs to cover a higher and increasing cost of capital. This is politically a very difficult position to hold, and fewer and fewer private operators are willing to do so, in particular in politically sensitive sectors, such as water and passenger transport.

What did we learn from the “infrastructure privatization” experience so far?

The experience of the past 15 years has also shown that the international community does not yet know how to address risk effectively. East Asia may have been the most effective in revealing that foreign exchange risk matters to infrastructure financing.³³ The first generation of public-private partnerships in East Asia was hit hard by the 1997 crisis. Almost 10 years later, these partnerships have not yet fully recovered, except in China. Experience in Eastern Europe and Africa has shown that there is still a long way to go to understand how institutional reforms work in this sector. It may be that reforms have to be introduced slowly. Better documentation is needed of just how counterproductive trying to force brutal institutional changes without taking the time to build the institutional capacity consistent with the desired reforms can be. The difficulties of implementing concession contracts, which are derived from an Anglo-Saxon legal tradition, in francophone Africa where lawyers were much more familiar with *affermage* contracts (more typical of the French legal tradition) illustrate the potential for problems. The importance of this risk in Africa has been less well studied than the intensity and the drivers of renegotiation in

³⁰ There is less of a tradition to rely on this yardstick among Francophone operators—at least in their assessment of potential markets since for the stock market, they do like everybody else and report the cost (and the return) on equity, one of the components on the costs of capital.

³¹ See Estache and Pinglo (2005) for all developing countries and Sirtaine and others (2005) for Latin America.

³² Sirtaine and others (2005) provide a detailed analysis of the evolution of the cost of capital in Latin America and compare it to the rate of return that can be estimated from the balance sheet of the main infrastructure operators in the region.

³³ Investors in Argentina would probably argue that the pesification of the economy implemented in January 2002 is the best evidence so far of what that risk means.

general and in Latin America in particular (see Guasch (2004)] for an overview of the issues in Latin America).

Latin America's recent experience has shown the need to study the social and political risks better, because they matter to the effectiveness of reforms and hence their sustainability. Reforming by decree without an effort to build up support is no longer an option. In this region, the poor have very clearly voiced their view on what kind of infrastructure services they want.³⁴ Very often this implies that policymakers have to understand how to better balance the concern for equity with the need for incentives to invest that has dominated the past 15 years of reforms. The experience also shows that it is worth looking more carefully into the options to ensure the commitment of government and operators to increased accountability to users and taxpayers. This can be achieved by adopting regulatory models that allow transparent documentation of efficiency, equity, and fiscal considerations.³⁵

The experience also shows that politics matter. Anecdotes from Asia, Eastern Europe, and Latin America show that politicians are unlikely to give up control of a sector that buys votes in democratic societies. Moreover, in societies in which corruption is rampant, they will not give up control of a sector involving large amounts of money and in which contract award processes often provide opportunities for unchecked transactions.

The Upshot...

The debate on the role of the public sector in infrastructure continues to be one of the hottest in the academic literature and in political circles. Ideology continues to taint the facts and their interpretation. This debate is possible simply because the facts reveal a very complex and sometime inconsistent picture. The privatization wave has delivered on some of its promises but not all of them. Efficiency generally improved but many argue that most of it should be credited to increased competition and in the case of telecoms to a simultaneous technological revolution. It has not delivered as much as expected in terms of investments and those without access to begin one are the most penalized by this failure.

Looking ahead, investors, operators and governments seem to be internalizing the main lessons of the 1990s and are increasingly effective at dealing with risk mitigation. Investors are working more in sectors which are safe bets (i.e. telecoms). They are also more effective at picking the cherries on the cakes. The number of large scale concessions covering all the operations of a sector is shrinking. Sector wide responsibilities are increasingly being covered by management or lease contracts which require no private investment. Where investment is taking place, it is done through various types of

³⁴. The rejection of the infrastructure reforms of the 1990s, in particular the increased role of the private sector in the delivery of services, did not play a minor role in the wave of political change in Argentina, Bolivia, Brazil, Uruguay, or Venezuela.

³⁵. Indeed, reforms often have fiscal costs, often generated as part of renegotiations that could have been anticipated if consistency framework documenting the sources of costs and incomes of the regulatory operators accounting for reasonable demand forecast had been adopted more widely. Of crucial importance is the need to recognize that the gap between the rate of return of the business and the costs of capital will be paid by taxpayers or users. It turns out that the taxpayer has been called upon much more often than is sometimes recognized. See Campos and others (2003) on the actual fiscal cost of the sector after 10 years of reform in Latin America

greenfield projects for specific investments (i.e. bulk facilities such as power plants and water treatment plants).

On the financial design, many of these projects face increasing costs of capital. To lower this hurdle, many contracts now include off-take agreements increasing the share of risk taken on by the government upfront (rather than reassigning it through ex-post renegotiations). This has opened the door to many new operators from developing countries, led by China and India but also many local country or region specific actors more familiar with the specificities of the local market and often more effective at dealing with local political sensitivities. Some challenges are likely to continue. Unless these firms are not depending on any imports or foreign financing, they are likely to be subject to foreign exchange risks similar to those faced by the first generation of private investors and operators in the sector.

The market for government sponsored guarantees against these risks is unlikely to shrink any time soon. The real question is whether the international financial community, private and public, is willing to scale up their support to private operators working in an environment in which many risks are better known but many more seem to spring on a regular basis. In the mean time, as long as the private sector does not take the lead or is unable to do so for a variety of economic and political reasons, it seems reasonable to expect that governments will have to get their act together and take on the responsibility for delivering the services somehow.

How is the role of the state in infrastructure evolving?

There are three basic debates on the role of the state in infrastructure. The first is the debate on the extent to which the public sector should or not continue to be the main provider of these services. The second is about how the government should deliver its regulatory responsibility in a sector which is characterized both by market failures and by an extreme sensitivity to political pressure. The final one is about the optimal allocation across government levels for these two main responsibilities.

What share of the services is the public sector delivering?

This is not as obvious a question as it seems. The answer requires an unbundling of infrastructure services and physical infrastructure. In most developing countries—as well as in many developed countries --, the physical infrastructure is to a large extent public. Railway tracks, roads, ports, water pipes, most basic infrastructures associated with fixed telephony, electricity transmission and distribution or gas transport are owned and generally operated by the public sector. Of course there are exceptions and there are plenty of projects which provide an exception to that rule. But these exceptions do not put in question the basic fact that this is a sector in which the state continues to be responsible for a large share of the financing of the physical infrastructure necessary to produce the basic infrastructure services.

Table 6 reproduces the data from Table 5 from the viewpoint of the countries that do not have a major private actor in infrastructure in their country. In about two thirds of the developing countries, the state is the main actor in electricity distribution, water distribution and railways services. In over 50% of the countries, it is also the main actor in electricity generation. It is only in fixed telecoms services that there are fewer countries in which the state is the main actor than countries in which the private sector dominates.

Table 6. Percentage of countries WITHOUT significant large scale private investment in infrastructure (2004)					
Income level	Electricity generation	Electricity distribution	Water and sanitation	Railways	Fixed-line telecoms
Low	59	71	82	66	50
Lower-middle	52	63	50	74	38
Upper-middle	42	52	63	40	28
Developing	53	64	65	64	41

Source: Estache and Goicoechea 2005.

Note: Data for railways are from 2002.

In terms of investment, it is useful in this context to also revisit the information provided under the previous section under the public sector angle. About 80% of the amount of infrastructure investments realized in the last 15 years in the infrastructure sector was public. Considering the fact that many of the deals signed during the 1990s in water and transport were renegotiated and that many of these renegotiations resulted in a demand for investment and operational subsidies from the state, it is very likely that this figure is a lower band (Campos et al (2003)).

From a very pragmatic viewpoint, the main problem is that depending on the country group, this investment is still 50 to 120% lower than what is needed to support the growth rates claimed to be needed to support high growth rates. The lower the income level, the higher the investment gap. This existence of such a gap is in fact what prompted many governments to reform to begin with. Most countries did not think the state was doing a good job at delivering these services. We know now that the private sector is unlikely to pick up the ball or at least to do soon the scale needed for the poorest countries to get out of poverty and for the middle income countries to get the critical mass they need to make the last jump to high income countries.

This has two implications which need to be addressed by the international community. The first is that it is essential for donors to help scale up the investment efforts—just like it has to be done in health and education. The second is that it is essential for countries to learn how to deliver public services better. The foreign private sector may take on the management or operation of many services and over time pass on the knowledge to those countries that need it the most. But in many countries, the scale of the problems is so large that management contracts or leases won't be possible. Structural reforms are needed in the way the public enterprises are run. Unfortunately, it looks like we collectively stopped learning anything about this in the last 20 years (Gomez-Ibanez (2006)). A lot of work is needed in this field and the debates on how to proceed are likely to be as ideological as the debates on privatization has been for quite some time now. The leading advice for now

seems to more systematically corporatize the public operators in the sector and to possibly name private managers to run the operations.³⁶ But this requires a non trivial political commitment to avoid other forms of interference with the management of the public services.

How should the government regulate its public services?

Self regulation by the state or often by the public enterprises themselves has been one of the major criticisms addressed to the way the infrastructure sector was operated until the 1990s. The recognition that conflict of interest and excessive political interference could eventually hurt the users led to the promotion of the idea that regulators should be independent from the political powers. This implied the creation of autonomous regulatory agencies which would be run by an individual or a board of directors which would be recruited for their skills and for a specific term independent of the political cycles and which would enjoy their own sources of revenue. To many, this was also a way of increasing the transparency of transactions in the sector and hence of reducing the scope for corruption.³⁷ The creation of this sort of agency would also be a signal to the markets that the governments were willing to cut the regulatory risks.

Recent evidence by Andres et. al. (2007) suggests that regulators across sectors in Latin America that were established under law, funded by regulatory fee, and with a fixed-term regulatory commission screened by legislators, more effectively aligned cost of capital and rate of return. Gasmi et al. (2002) find equivalent results in the case of the telecoms sector for a world wide sample.

Table 7 provides a snapshot of the position of countries with respect to this dimension of the role of government. Clearly, the idea of independent regulation has been mainstreamed in the telecom sector and to some extent in the energy sector. It is much less popular in the water and transport sectors. Also, as with private sector participation in infrastructure, it is an approach more likely to be adopted by richer countries. This is somewhat to be expected since the poorest countries face a significantly stronger capacity constraint in terms of human capital. In many countries, there is a sense that the opportunity costs of earmarking the good people to specialized agencies may be too high.

Table 7. Percentage of countries with independent regulatory agencies, by sector, 2004				
Income level	Electricity	Water and sanitation	Railways	Fixed-line telecommunications
Low	38	13	2	69
Lower-middle	63	32	8	60
Upper-middle	63	28	19	71
Developing	51	22	8	66

Source: Estache and Goicoechea 2005.

³⁶ Corporatization has complex implications for project selection. There is a risk to get public enterprise to favor financial criteria over economic criteria for project selection unless the mandate is clear to avoid doing so. With the increased concerns for major externalities, this is no a minor issue which is probably not getting the attention it deserves in policy circles and has long been out of fashion in academic circles.

³⁷ For recent surveys of infrastructure and corruption, see Kenny (2006, 2007)

Note: Data for railways are from 2002.

In addition to the capacity issues, two broad concerns are emerging in the countries which have adopted the idea of an independent regulator. The first is that there is a widespread sense among specialists that economic regulation and regulatory processes need to be taken much more seriously. They are essential in terms of the reduction of the opportunities for corruption. They are also essential in terms of ensuring of a fair distribution of the rents generated by the remaining public and private monopolies in the sector. Accounting rules, contracts, regulatory processes and consultations, tariff or investment review procedures and methodologies, timetables tend to lack the transparency needed for the accountability of these independent actors. This is not a minor problem. For instance, Bertolini (2006) finds in a survey of regulators in 2005 that less than 30 percent of regulators currently publish contracts and licenses.

But the experience suggests that the implementation of the idea is not obvious and may not be appropriate at all stages of development. Eberhard (2007) for instance show why a poor independent regulator may be worse than no regulator in some circumstances. There are alternative models for the effective regulation of public and private operators which reduce the risks to the users, the taxpayers and the operators. For instance, independent auditors recruited on a retainer basis and with the obligation of conducting regularly scheduled audits and to be available for extraordinary audits have long been considered. The regulation of various African railways concession and of some of the Eastern European water concessions offers a variation around this model. In all cases, the external auditors are supported by local units within the Ministries or even as independent agencies. The resolution of the debate on the need for an independent regulator seems to be progressing slowly towards more a pragmatic approach with recognizes the local specificities. One size does not fit all and it never did. Progress is being made but still has some way to go.

Does decentralization help the performance of the sector?

Decentralization is the third main topic in discussions of the changes needed in the public sector. Since the 1970s many countries, particularly developing countries, have seen major shifts of responsibilities for expenditure and financing decisions to subnational government levels. The responsibility for most urban services (urban buses and railways, water and even some road constructions) is very often a municipal one. In view of the fast urbanization of most countries of the world, the relative importance of these mandates is likely to increase. It is also resulting in tense discussions between the various government levels on the appropriate match between the allocation of responsibilities of expenditures and of revenue across infrastructure services.

This core policy agenda has generated a lot of interesting academic work on decentralization design but very little directly relevant to infrastructure. Bardhan and Mookherjee (2000, 2003) offer some of the most influential recent theoretical findings on infrastructure, highlighting the role of local corruption on the effectiveness of public service decentralization. They show that under fairly mild assumptions, decentralization, financed by user fees rather than local taxes or intergovernmental grants, generates more

efficient outcomes, no matter how poorly local democracy works. The problem is when some of the assumptions are released to account for relatively common real life situations. First, if user fees are not used—and full cost recovery is only very partial for many services—, the superiority of decentralized over centralized service provision is no longer as clear-cut. Second, when ability to pay is constrained and user charges cannot be used to finance antipoverty programs, the optimal degree of decentralization depends on the degree of corruption in local and central governments. Most of the academic work on infrastructure decentralization is however theoretical. For now, there are relatively reliable empirical tests (see Shah, Thompson, and Zhou 2004 for a general survey and Mookherjee and Bardhan (2006) for one more focused on infrastructure).

The literature provides a few robust insights. First, decentralization tends to increase total and subnational spending on infrastructure, and even more so in developing than in industrial countries (Estache and Sinha 1995, Fisman and Gatti 2002, Faguet 2004). This can have two explanations: (i) centralized regimes tend to ration demand for infrastructure services; (ii) decentralization, by reducing the scale of service delivery, increases the unit costs. Second, the interaction between infrastructure, corruption and any form of decentralization is not a simple one. Fisman and Gatti (2002) conclude to a negative correlation between corruption and decentralization but Faguet does not find a strong relation either way. Olken finds that good centralized audits outperform decentralization in reducing the effects of corruption, at least for road maintenance. Finally, fiscal decentralization significantly affects the level and frequency of private participation but administrative and political decentralization do not. Fiscal decentralization tends to increase private sector participation in infrastructure (Ghosh Banerjee 2006).

The literature and the policy advice on participatory approaches to service delivery can also be seen as an extension of the work on decentralization and points to additional insights of direct relevance to the debate on the pros and cons of decentralization. Ghazala (2004) and Cornwall (2003) observe that projects claiming “full participation” and “empowerment” have turned out to be driven by particular interests or elites, leaving the least powerful without voice or much choice. The poverty reduction effectiveness of these programs needs to be measured more systematically as well. The one quantitative study of an infrastructure activity is by Olken (2005), who finds that increasing grassroots participation had little impact in reducing corruption associated with road expenditure in Indonesia. He shows that top-down monitoring may be a better solution, even in a highly corrupt environment. In other words, traditional regulatory instruments have been more effective than participatory instruments in Indonesia’s road program.

But beyond decentralization’s impact on governance and responsiveness to local needs, there are concerns that it may be associated with a decrease in resources available for infrastructure. The concern stems from the fact that subnational governments tend to have substantially less access to private capital or international donors. Most face such severe credit constraints that their ability to finance infrastructure investments is limited in the absence of support from the central government. The central issue in setting up mechanisms to channel private savings to local bodies for the financing of infrastructure is the assurance to lenders that they will be repaid. But this is often not enough. Indeed, a major impediment to the development of subnational credit markets is the moral hazard of

explicit or implicit guarantees of a federal government bailout of subnational debt. For this reason, the development of subnational credit markets requires, inter alia, a strict no-bail-out policy for subnational governments in trouble. This approach has been adopted in Mexico where the capital risk weighting of bank loans to local governments is linked to local credit ratings.

The natural question that emerges is the extent to which the expected payoffs of decentralization may not be offset in the case of infrastructure by the loss of economies of scale and the reduced access to sources of financing already generally difficult to obtain for sectors with high cost lumpy investments and slow cash flows very sensitive to politics. One solution is clearly to simply pool credit risks of subnational governments. This makes sense but it boils down to a recentralization of some of the dimensions of infrastructure service delivery. The fact that this market has not developed yet very impressively in developing countries in spite of the strong political pressures in many of the middle income countries provide a good hint on the spread between the various viewpoint of the desirability and the limits of infrastructure decentralization.

The upshot

The role of governments in infrastructure is likely to continue to be a source of ideological debates for the foreseeable future. We know that governments will continue to play a key role as providers and financiers of the sector. We also know that governments have a regulatory role to play in a sector in which the residual monopolies are likely to be strong. However we also know that the implementation of the mandate to deliver is plagued with potential sources of political interferences.

The corporatization of public enterprises does not have a great track record in developing countries with a few exceptions in Asia. In most other countries, politics have tended to crawl back in the agenda of the public and private managers of these corporatized service providers within 3-5 years of their corporatization. Similarly, regulators do not have a very impressive record of a sustainable fair and efficient arbitration of the joint interests of users, taxpayers and operators. Independent regulators have been reasonably effective in the most advanced countries in telecoms and energy. However, they have encountered many problems in water and transport. In most cases, when a crisis has hit the sector, politicians have generally taken over the reign of regulation. Finally, because decentralization is generally more a political decision with economic and administrative consequences, the decentralized management of infrastructure services has been the victim of political disagreements across government levels which have hurt otherwise rational decisions.

Overall, a review of the experience of the last 15 years is sobering. In spite of the long history of analysis of the various potential roles of the state in infrastructure, most of the progress in learning how to get things done has come from the theoretical research. Policymakers have very few clear yardsticks or rules of thumbs they can use to set up reforms to get the public to deliver on any of its assignments—operation, financing or

management. Anecdotes and examples of best practice abound, credible specific guidelines are scarce.

Concluding comments

The heterogeneity of the infrastructure business is such that it is difficult to draw very specific conclusions for any given subsector or country from a broad-brush overview as this one. There are, however, some useful broad lessons of general interest.

The first may be that the basic debates have not changed that much over the last 25 years or so and they center around two core questions:

- *who should be in charge of the sector*: the government or the private sector; the central government or the subnational governments; and finally, independent regulators or politicians?
- *who should pay for the services*: the users, the taxpayers or in some case the donors.

There are plenty of variations and refinements around these two questions. These are driven by the relative importance assigned to the concern for efficiency, equity, financial viability and accountability. But the core questions have remained the same for the longest time. Unfortunately, although a lot of learning has taken place on how to address those questions, some of the basic answers are still lacking!

One of the main reasons for this lack of clear cut answers to the core questions is the lack of objective data on the sector. Data gaps have been highlighted throughout this overview, including on basic issues such as costs and tariffs or the share of public or private resources allocated to expand or maintain the sectors.

The last few years have seen the growth of subjective data based on questionnaires covering a wide range of topics such as the investment climate, corruption perception indicators or the sources of happiness for people. They have also seen the growth of refinements of household consumption and expenditure surveys to generate comparable data on much of a problem the sector is for residential users. But these multiple sources generate information rarely comparable across sources and continue to leave major gaps. Ultimately, these data gaps are what allows ideological debates to dominate substantive debates in this sector. For substantive answers to the core questions to emerge and to settle many of the debates summarized here without recourse to ideology, it is essential for the international community to take on the data agenda much more seriously than it has so far. Some progress is being made through the MDGs but there is still a long way to go.

References

- Adam, C. and D. Bevan. 2004. *"Aid and the Supply Side: Public Investment, Export Performance and Dutch Disease in Low Income Countries."* Oxford University, Department of Economics, Working Paper 201.
- Agenor, P. R. and B. Moreno-Dodson. 2006. "Public infrastructure and growth: new channels and policy implications." [*Policy Research Working Paper Series* 4064](#). The World Bank.
- Alam, A., M. Murthi, R.Yemtsov, E. Murrugarra, N. Dudwick, E. Hamilton, and E. Tiongson. 2005. *"Growth, Poverty and Inequality: Eastern Europe and the Former Soviet Union."* Washington, DC: The World Bank.
- Albala-Bertrand, J. and E. Mamatzadakis. 2004. "The Impact of Public Infrastructure on the Productivity of the Chilean Economy". *Review of Development Economics*, 8 (2), 266-278.
- Alesina, A., R. Baqir and W. Easterly. 1999. "Public Goods and Ethnic Divisions". *Quarterly Journal of Economics*, November 1999, Volume CXIV, Issue 4, pp. 1243-1284.
- Andres, L., J. Guasch and S. Straub. 2007. *"Does Regulation and Institutional Design Matter for Infrastructure sector Performance?"*. The World Bank, Washington DC, processed.
- Aschauer, D. 1989. "Is Public Expenditure Productive?" *Journal of Monetary Economics*, March.
- Aschauer, D. 2000. "Do States Optimize? Public Capital and Economic Growth". *The Annals of regional Science*, 34:343-363
- Baldwin, R. R. Forslid, P. Martin, G. Ottaviano and F.Robert-Nicoud. 2003. *Economic Geography and Public Policy*. Princeton University Press, Princeton, NJ.
- Bardhan, P and D. Mookherjee. 2006. "Decentralization, corruption and government and accountability: an overview", in S. Rose-Ackerman, *Handbook of Economic Corruption*, Edward Elgar, forthcoming.
- Bardhan, P and D. Mookherjee. 2000. "Corruption and decentralization of infrastructure in developing countries". *Economic Journal*.
- Bardhan, P and D. Mookherjee. 2003. *"Decentralization and accountability in infrastructure in developing countries"*. Boston University, processed.

- Bertolini, L. 2006. "How to Improve Regulatory Transparency", PPIAF Gridlines Note No. 11. Available at <http://www.ppiaf.org/>
- Boccanfuso et al. 2006. "*Water sector reform in Senegal: an interpersonal and interregional distributional impact analysis*". The World Bank, Washington DC, processed.
- Bougheas, S., P. Demetriades, and T. Mamuneas. 2000. "Infrastructure, Specialization and Economic Growth". *Canadian Journal of Economics*, Vol. 33, No. 2.
- Brenneman A. 2002. "*Infrastructure and poverty linkages: a literature review*". The World Bank, Washington DC.
- Briceño, C. and I. Klytchnikova. 2006. "*Infrastructure and Poverty: What data are available for impact evaluation*". The World Bank, Washington DC, processed.
- Briceño, C., A. Estache and N. Shafik. 2004. "*Infrastructure Services In Developing Countries: Access, Quality, Costs and Policy Reform*". The World Bank.
- Cadot, O., L. H. Roller and A. Stephan. 2006. "Contribution to Productivity or Pork Barrel? The two Faces of Infrastructure Investment". *Journal of Public Economics* 90: 1133-1153.
- Calderon C. and Servén, L. 2004. "The Effects of Infrastructure Development on Growth and Income Distribution". [*World Bank Policy Research Working Paper No. 3400*](#), The World Bank, Washington DC.
- Campos, J., A. Estache, N. Martin, and L. Trujillo. 2003. "*Macroeconomic Effects of Private Sector Participation in Infrastructure*", in Easterly, W. and L. Servén, *The Limits of Stabilization*, Stanford University Press, Stanford.
- Canning, D. and E. Bennathan. 2000. "The Social Rate of Return on Infrastructure Investment," The World Bank, *Policy research working paper 2390*, Washington, D.C.
- Canning, D. and P. Pedroni. 2004. "The Effect of Infrastructure on Long Run Economic Growth". The World Bank, Washington DC, processed.
- Cavalcanti Ferreira, P. and L. Gonçalves do Nascimento. 2005. "*Welfare and growth Effects of Alternative Fiscal Rules for Infrastructure Investments in Brazil*." The World Bank, Washington, D.C. (also available as *Ensaio Econômico* EPGE 604, 11/2005; <http://epge.fgv.br/portal/pessoas/docente/2008.html>).
- Chen, Kuo and Chen. 2007. "The Relationship between GDP and Electricity Consumption in 10 Asian Countries". *Energy Policy* 35, pp.2611-2621
- Chisari, O., A. Estache and C. Waddams-Price. 2003. "Access by the poor in Latin America's utility reform: subsidies and service obligations" in C. Ugaz and C.

- Waddams Price, ed. *Utility Privatization and Regulation: A Fair Deal for Consumers?* Edward Elgar, Northampton, Ma, USA
- Clarke, G. and S. Wallsten. 2002. "Universal(ly Bad) Service: Providing Infrastructure Services to Rural and Poor Urban Consumers". *World Bank Policy Research Working Paper* No. 2868, World Bank, Washington DC.
- Cohen, B. 2004. "Urban Growth in Developing Countries: A review of current trends and a caution regarding existing forecasts". *World Development*, 32 (1), 23-51.
- Combes, P.P. and M. Lafourcade. 2001. Transportation costs decline and regional inequalities: Evidence from France, 1978-1993. *Discussion Paper 2894*, Centre for Economic Policy Research, London, UK.
- Cornwall A. 2003. "Whose voices? Whose choices? Reflection on gender and participatory development". *World Development* 31(8): 1325–1342.
- Cremer, H., F. Gasmi, A. Grimaud and J.J. Laffont. 2001. "Universal Service: an Economic Perspective Overview". *Annals of Public and Cooperative Economics*, vol. 72, n. 1.
- De la Fuente, A. and X. Vives. 1995. "Infrastructure and education as instruments of economic policy: Evidence from Spain". *Economic Policy*, No 20, April.
- De la Fuente, A. 2002a. "Is the Allocation of Public Capital across the Spanish Regions Too Redistributive?". *CEPR Discussion Paper Series No. 3138*.
- De la Fuente, A. 2002b. "The Effect of Structural Fund Spending on the Spanish Regions: an Assessment of the 1994-99 Objective 1 CSF", *CEPR Discussion Paper Series No. 3673*.
- Duggal, V., C. Saltzman and L. Klein. 2006. "Infrastructure and Productivity: An Extension to Private Infrastructure and IT productivity", *Journal of Econometrics* 10:1016.
- Ebinger, J. 2006. "Measuring Financial Performance in Infrastructure: an Application to Europe and Central Asia". *Working Paper Series No. 3992*, The World Bank, Washington DC.
- Eberhard, A. (2007), Matching regulatory design to country circumstances, Grid Lines, Note No23, May, PPIAF
- Estache, A. and R. Munoz. 2007. "*Building sector concerns into Macroeconomic Financial Programming: Lessons from Senegal and Uganda*". The World Bank, Washington DC, processed.
- Estache, A. and Q. Wodon. 2007. "*Infrastructure and Poverty in Africa*". The World Bank, Washington DC, processed.

- Estache, A., B. Speciale, and D. Veredas. 2006. "How Much Does Infrastructure Matter to Growth in Sub-Saharan Africa?". The World Bank, Washington, DC, processed.
- Estache, A. and A. Goicoechea. 2005. "How widespread were infrastructure reforms during the 1990s". *World Bank Research Working Paper 3595*.
- Estache, A. and M.E. Pinglo. 2005. "Are returns to Public-Private Infrastructure Partnerships in Developing Countries Consistent with Risks since the Asian Crisis", *Journal of Network Industries*.
- Estache, A., V. Foster and Q. Wodon. 2002. "Accounting for Poverty in Infrastructure Reform – Learning from Latin America's Experience". World Bank Institute Publications, Studies in Development Series.
- Estache, A. and M. Fay. 1997. "Ensuring Regional Growth Convergence in Argentina and Brazil: How can Governments Help?" The World Bank, Washington DC. Processed.
- Estache, A. and S. Sinha. 1995. "Does decentralization increase spending on infrastructure?" *World Bank, Policy Research Working Paper, Number 1995*.
- Esfahani, H. and M.T. Ramirez. 2003. "Institutions, infrastructure, and economic growth", *Journal of Development Economics*, April 2003, vol. 70, 2, pp. 443-477(35).
- Faguet, J.P. 2004. "Does decentralization increase government responsiveness to local needs: Evidence from Bolivia", *Journal of Public Economics*, v 88, pp 867-893.
- Faini, R. 1983. "Cumulative process of deindustrialization in an open region: the case of Southern Italy, 1951-1973." *Journal of Development Economics* 12 (3): 277-301.
- Fay, M. and M. Morrison. 2007. "Infrastructure in Latin America and the Caribbean – Recent Development and Key Challenges." The World Bank, Washington DC. Available at <http://info.worldbank.org/etools/docs/library/240065/Infrastructure%20in%20Latin%20America%20%20recent%20developments%20and%20key%20challenges%20Vol.2%20.pdf>
- Fay, M. and T. Yepes. 2003. "Investing in Infrastructure: What is needed from 2000-2010". *World Bank, Policy Research Working Paper, 3102*.
- Fernald, J. 1999. "Roads to Prosperity? Assessing the link between Public Capital and Productivity." *The American Economic Review*, June 1999, 89(3), pp619-38.
- Fisman, R. and R. Gatti. 2002. "Decentralization and corruption: evidence across countries." *Journal of Public Economics*, 83, 325-345.
- Foster, V. and T. Yepes. 2006. "Is cost recovery a feasible objective for water and electricity ? The Latin American experience." *World Bank, Policy Research Papers, No 3943*, Washington, DC.

- Gasmi, F., M.D. Kennet, J.J. Laffont and W.W. Sharkey (2002), *Cost Proxy Models and Telecommunications Policy*, MIT Press, Cambridge, Ma.
- Gassner, K., A. Popov and N. Pushak. 2007. "An empirical assessment of private participation in electricity and water distribution in developing and transition economies." The World Bank, Washington DC, processed.
- Ghazala, M. 2004. "Community-based and -driven development: a critical review." *World Bank Research Observer*, 19 (1), 1-39.
- Gibson, J. and S. Rozelle. 2001.
- Gibson, J. and S. Rozelle, 2002. "Poverty and Access to Infrastructure in Papua New Guinea." Department of Agricultural & Resource Economics, UC Davis, Working Paper Series No. 1000.
- Ghosh Banerjee, S. 2006. "Decentralization's impact on private sector participation in infrastructure investment in developing countries." The World Bank, Washington DC, processed.
- Gomez-Ibanez, J. A. 2006. "Alternatives to Privatization Revisited: The Options for Infrastructure". Infrastructure Vice Presidency, The World Bank, Washington DC, processed.
- Gramlich, E.M. 1994. "Infrastructure Investment: A review Essay." *Journal of Economic Literature* 32:1176-1196.
- Guasch, J.L. 2004. "Granting and Renegotiating Infrastructure Concessions: Doing it Right." WBI Development Studies, The World Bank, Washington DC.
- Henderson, V. 2002. "Urbanization in Developing Countries", *World Bank Research Observer*, 17(1), pp89-112.
- Henderson, V., Shalizi, Z. and A. Venables. 2001. "Geography and Development". *Journal of Economic Geography*, 1,1, 81-105.
- Henderson, V. and A. Kuncoro. 1996. "Industrial Centralization in Indonesia". *World Bank Economic Review* 10, pp513-540.
- Hurlin, C. 2006. "Network Effects of the Productivity of Infrastructure in Developing Countries." *Policy Research Working Paper Series No. 3808*, The World Bank, Washington DC.
- Iimi, A. and J. Wilson Smith. 2007. "What is Missing between Agricultural Growth and Infrastructure Development? Cases of Coffee and Dairy in Africa." World Bank, Washington DC. Processed (forthcoming in the World Bank Policy Research Working Paper Series).

- International Energy Agency. 2006. *World Energy Outlook*, Paris, France.
- Ingram, G. and Liu, Zh. 1999. "Determinants of motorization and road provision." *Policy Research Working Paper 2042*, The World Bank, Washington DC.
- Jacoby, H. G. 2000. "Access to markets and the benefits of rural roads." *Economic Journal*, 100, July, 717-737.
- Kalaitzidakis, P. and S. Kalyvitis. 2004. "On the Macroeconomic Implications of Maintenance in Public Capital." *Journal of Public Economics* v88, n3-4, 695-712.
- Kamps, C. 2005. "Is There a Lack of Public Capital in the European Union?" *European Investment Bank Papers*, vol. 10, No. 1, pp 73-93.
- Kariuki, M., and J. Schwartz. 2005. "Small-Scale Private Service Providers of Water Supply and Electricity: A Review of Incidence, Structure, Pricing, and Operating Characteristics". *World Bank Policy Research Working Paper 3727*, The World Bank, Washington, D.C.
- Kenny, C. 2006. "Measuring and reducing the impact of corruption in infrastructure," *Policy Research Working Paper Series 4099*, The World Bank.
- Kenny, C. 2007. "Infrastructure governance and corruption : where next ?," *Policy Research Working Paper Series 4331*, The World Bank.
- Komives, K., V. Foster, J. Halpern and Q. Wodon. 2005. "*Water, Electricity, and the Poor: Who Benefits from Utility Subsidies?*" The World Bank, Washington, DC.
- Laffont, J.J. 2005. "*Regulation and Development*." Cambridge University Press.
- Lall, S. and Wang. 2006. "Improving the Development Impact of Infrastructure, Proposal for a research program grant on infrastructure." The World Bank, Washington DC, processed.
- Lall S. V., R. Funderburg, and T. Yepes. 2003. "Location, Concentration, and Performance of Economic Activity in Brazil." *Policy Research Working Paper 3268*, The World Bank.
- Lanjouw, P. 1999. "Policy options for employment in the rural non-farm sector." *Rural Development Note, No 4*. The World Bank, Washington DC.
- Lokshin, M. & Yemtsov, R. 2005. "Who bears the cost of Russia's military draft?" *World Bank Policy Research Working Paper Series 3547*, The World Bank, Washington DC.
- Lipton, M. 1977. "*Why poor people stay poor: Urban Bias in World Development*." Harvard University Press, Cambridge, MA.

- Mellor, J. 1976. *"The New Economics of Growth."* Ithaca, NY: Cornell University Press.
- Nellis, J. and N. Birdsall. 2005. *"Reality Check: the Distributional Impact of Privatization in Developing countries."* Center for Global Development, Washington, D.C.
- Olken, B. A. 2005. *"Monitoring Corruption: Evidence from a field experiment in Indonesia"*, Harvard University and NBER
- Puga, D. 2002. "European regional policies in light of recent location theories." *Journal of Economic Geography*, 2, 373-406.
- Rauch, J. 1995. "Bureaucracy, Infrastructure, and Economic Growth: Evidence from U.S. Cities during the Progressive Era." *American Economic Review*, vol. 85, No. 4, pp 968-979.
- Ravallion, M. 2002. "On the Urbanization of Poverty." *Journal of Development Economics*, 68(2), 435-442.
- Ravallion, M. 2003. "The Debate on Globalization, Poverty and Inequality: Why Measurement Matters." *World Bank Development Research Group Working Paper 3038*.
- Reardon, T. 2001. "Rural Non-Farm Income in developing countries." Report to the FAO.
- Renkow, M., D.G. Hallstrom and D.D. Karanja. 2004. "Rural infrastructure, transaction costs and market participation", *Journal of Development Economics*, 73, pp349-367.
- Rioja, F. K. 2001. "Growth, Welfare and Public Infrastructure: A General Equilibrium Analysis of Latin American Economies." *Journal of Economic Development* 26(2).
- Rioja, F. 2003. "Filling Potholes: Macroeconomic Effects of Maintenance vs. New Investments in Public Infrastructure." *Journal of Public Economics*, v87, n9-10: 2281-2304.
- Robinson, J. and R. Torvik. 2005. "White Elephants." *Journal of Public Economics*, 89, pp 197-210.
- Roller, L.H. and L. Waverman. 2001. "Telecommunications Infrastructure and Economic Development: A simultaneous Approach." *The American Economic Review*, Vol. 91, No 4, pp 909-923.
- Romp W. and J. de Haan. 2005. "Public capital and economic growth: a critical survey." *EIB Papers*, Volume 10 no1/2005, European Investment Bank, Luxemburg. Available at: <http://www.eib.org/infocentre/publications/eib-papers-volume-10.-n12005.htm>.

- Schur, M., S. von Klaudy and G. Dellacha. 2006. “*The role of developing country firms in infrastructure: A new class of investors emerges.*” Gridline Notes No. 2, PPIAF, available at <http://www.ppiaf.org/Gridlines/3global.pdf>.
- Shah, A., T. Thompson and H.F. Zhou. 2004. “The Impact of Decentralization on Service Delivery, Corruption, Fiscal Management and Growth in Developing and Emerging Market Economies: A Synthesis of Empirical Evidence”, *CESifo Dice Report 2*: 10-14.
- Sirtaine, S., M.E. Pinglo, V. Foster and J.L. Guasch. 2005. “How profitable are private infrastructure concessions in Latin America? Empirical evidence and regulatory implications.” *Quarterly Review of Economics and Finance*, 45, 380-402.
- Straub, S. and C. Vellutini. 2006. “*Assessment of the Effect of Infrastructure on Economic Growth in the East Asia and Pacific Region*”. The World Bank, Washington DC, processed.
- Ugaz, C. and C. Waddams Price. 2003. “*Utility Privatization and Regulation: A Fair Deal for Consumers?*” Edward Elgar: Cheltenham.
- Van de Walle, D. 2002. “Choosing Rural Road Investments to Reduce Poverty,” *World Development*, 30(4): 575-589.
- Van de Walle, D. and Nead. 1995. “*Public Spending and the Poor: Theory and Evidence.*” Johns Hopkins University Press, Baltimore.
- Vickerman, R. K. Spiekermann and M. Wegener. 1999. “Accessibility and Economic Development in Europe.” *Regional Studies* 33(1):1-15.
- World Bank. 2007. “*Argentina: Infrastructure for Growth and Poverty Alleviation.*” The World Bank Washington DC, processed.
- World Bank. 2005a. *Global Monitoring Report 2005: Millennium Development Goals - From Consensus to Momentum*. The World Bank, Washington, D.C. Available at <http://www.worldbank.org/reference/>
- World Bank. 2005b. “*Mexico: Infrastructure Public Expenditure Review.*” Report No. 33483-MX, The World Bank, Washington DC. Available at: <http://www.worldbank.org/reference/>